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Design Patterns for Effective Technology Enabled Learning

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Abstract— *As always seen from past times, the most effective way of learning is via observing, imitating and participation. But with advent of technology in our daily lives, the use of information and communication technologies (ICT) in learning is quite essential. The use of technology has brought about radical changes in the field of distance education. Also for successful progress of any interactive learning environment, the role of an efficient Design is very crucial. In this paper we firstly discuss the role of an effective design pattern, secondly the need of Technology Enabled Learning (TEL) and finally elaborate on the various design patterns that can be applied in the field of TEL.*

Keywords— Student-Centric Learning, Interactive Lecture model, Design Pattern, ICT, TEL, Student Blog, Peer, Taxonomy.

I. INTRODUCTION

The term Technology-enhanced learning (TEL) is used to describe the application of information and communication technologies to teaching and learning [1]. The design methodology for TEL is a big challenge as it needs to cater to a range of issues from understanding basic requirements of learning theory to designing software solutions for effective TEL tools. Also in today's world due to rapid technological advancements, instructors or teachers face huge difficulties in designing and using new learning tools. Generally, the kind of help which is provided is either in the form of pedagogical theories or in the form of informal descriptions of someone else's practice. The pedagogical theories are usually too general and methodical to be useful and the descriptions are often too ad hoc or context precise to be easily applicable more broadly. Hence the teachers face a daunting task of finding out what is relevant and what is not and build the course material in a cumulative manner. Design Patterns comes to aid this task and make the entire teaching-learning process effective [2].

II. DESIGN PATTERNS

2.1 Introduction

Christopher Alexander says, "*Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice*" (Alexander et al, 1977, p.x). In *The Timeless Way of Building* Alexander [3] elaborates:

Each pattern is a three-part rule, which expresses a relation between a certain context, a problem, and a solution.

As an element in the world, each pattern is a relationship between a certain context, a certain system of forces which occurs repeatedly in that context, and a certain spatial configuration which allows these forces to resolve themselves.

As an element of language, a pattern is an instruction, which shows how this spatial configuration can be used, over and over again, to resolve the given system of forces, wherever the context makes it relevant.

The pattern is, in short, at the same time a thing which happens in the world, and the rule which tells us how to create that thing, and when we must create it. It is both a process and a thing; both a description of a thing which is alive, and a description of the process which will generate that thing (Alexander, 1979, p 247).

Design Patterns provide the educators practical and usable ideas with customizable solutions that they can apply to their teaching process. The patterns are open for modifications, revisions and are extensible to make them more relevant to their subject area.

2.2 Pedagogical Design Patterns

Pedagogical design patterns relate the concept of design patterns to educational design [4]. Pedagogical patterns try to gather skilled knowledge of the practice of teaching and learning. To capture the real meaning of the subject in a compact form that can be easily taught to those who need the knowledge is the main goal of these patterns. Presenting this information in a logical and available form can mean the variation between every new instructor needing to relearn what is identified by senior faculty and easy transference of knowledge of teaching within the community.

2.3 Need for Design Patterns in Technology-Enabled Learning

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Design Patterns present to us a design experience in form of design problem and design solution [5]. The patterns-based approach offers a way of capturing design experience that:

- Combines identifiable problems with tested solutions
- Identifies to design problems at any scale level (micro, meso, macro, etc), and connects design solutions across scale levels
- Can be supported with research-based evidence
- Gives guidance but can be extended with creativity
- Has wide application but is customisable to meet specific needs

Design approaches in technology-enabled learning have a distinct unifying constraint: the learner. Every design pattern developed aims to make the learner achieve an insight into a particular subject and each design approach supports this underlying philosophy. Design Pattern tools have the potential to be used by researchers for performing intricate TEL-related tasks. They can also be designed and used as a practical tool; for example, directly resolving TEL design issues with regard to technological development and tool deployment. Essentially, once patterns are available, anyone involved in the TEL development process can take them, in any variety of combinations, and use them to (collaboratively) design their own tools. Additionally, each pattern can be evaluated and modified to take into account the context of use [4].

III. STUDENT-CENTRIC LEARNING DESIGN PATTERN

The concept of student–centred learning has been credited as early as 1905 to Hayward and in 1956 to Dewey's work (O'Sullivan 2003). Carl Rogers, the father of client–centred counseling, is associated with expanding this approach into a general theory of education (Burnard 1999; Rogoff 1999) [6].

In Student-Centric learning, the knowledge about a particular topic is constructed by student groups and the teacher just facilitates the whole process [2],[3]. The focus here is on what the student has achieved rather than what has the teacher taught. It addresses the need for active and deep understanding of the student instead of his passive learning. Brandes and Ginnis (1986) in their book for use in second level education (post–primary), entitled 'A Guide to Student–Centred Learning', have presented the main principles of student–centred learning as:

- The learner has complete responsibility for her/his learning
- Involvement and participation are a must for learning
- The relationship between learners is more equivalent, encouraging growth, development
- The teacher becomes a facilitator and resource person
- The learner experiences convergence in his education (affective and cognitive domains flow together)

3.1 Technology enhanced student-centric learning

Student-centred learning environments have been regarded as an alternative to externally-directed instruction. While, at face value, the potential of student-centred learning environments is compelling, the ground problems associated with implementing them are daunting. Recent advancements in computer and related technologies, however, have facilitated the management of e-resources, making student-centred options both possible and feasible. Technology-enhanced learning environments "promote engagement through student-centred [learning] activities" (Hannafin, 1992, p. 51). Computer-enhanced, student-centred learning environments organize interrelated learning ideas into meaningful contexts, often in the form of a problem to be solved or an orienting goal, that functionally bind their features and activities. They promote interactive, flattering activities that facilitate individuals to address unique learning interests and needs, study different levels of complexity, and deepen their subject knowledge. They establish conditions that enrich thinking, understanding and learning, and use technology to enable flexible methods through which the processes can be supported [7]. As seen technology-enabled student-centric learning has many benefits, in this paper we have discussed two design patterns for the same: Interactive Lecture Mode and Student Blog.

3.2 Design Pattern: Interactive Lecture Mode

Traditionally schools, universities and adult education providers have implemented a "lecture-based" teaching model. This approach to learning was developed during the industrial age, some centuries ago. The concept is for students to sit passively in rows of chairs or tables all in front of the presenter, who usually resides at a lectern. A lecture is a "one-to-many" form of communication, involving little or no audience participation. By nature, it is authoritarian, For an information dump a lecture works fine. Unfortunately, for any type of profound learning to take place more interactive teaching methods must be

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utilized. Modern brain science suggests that human beings are not wired to learn passively.

Sonja Kabicher & Renate Motschnig-Pitrik suggested this efficient design pattern named Interactive Lecture Mode [8]. This pattern proposes that knowledge about a particular subject can be offered to students via interactive learning instead of traditional classroom teaching. The students can form group and submit project proposals related to the subject. They have to explain the motivation and intent behind the proposal and submit the goals of the project. The project can then be peer-reviewed by other student groups and the final evaluation would be carried out by the teacher. This pattern helped the students grasp the subject knowledge more efficaciously [5]. This pattern supports instructors who aspire to teach their students in a learner-centred way and to support deep and meaningful learning. The pattern helps to design and implement an interactive mode of lecture in academic courses by including (1) an electronic diary (or e-portfolio) service, (2) interactive spaces for team projects, and (3) personal as well as interpersonal reflection.

The goals and the purpose of the interactive lecture mode might be highlighted, namely:

- the support of students, with space for deepening core lecture topics and their own interests in the subject
- collection of their own experiences in self-initiated and guided processes
- reflection on subject-specific and personal learning
- enhancement of social interaction
- support of their own research if desired
- reduction of pressure that may arise from focused learning for the final exam by guiding students through several learning activities that lead to a particular level of achieving the course's learning outcomes

3.2 Design Pattern: Student Blog

Micheal Derntl proposed this competent design pattern wherein student can create his own blog to share his queries, insights, etc. regarding a particular topic [9]. A blog can be considered as a personal journal where the student can give his own opinions, comments regarding a particular task assigned, the knowledge they gained from that task, the reason if they were unable to perform a particular task, future amendments to the task, so on and so forth. The blogs can be then published on a shared blogging portal wherein other students and the teacher can access and share their views. Such kind of blogs can make the overall learning experience to be fun and engaging [10].

Some of the benefits of using blogs are as follows:

- The blogs offer rich sources of insight into student learning processes. Students can share in detail on how they tried to solve the given assignments, describing the problems they encountered, explaining and sometimes 'showing off' the solutions they came up with.
- The students can use all sorts of fancy technology gadgets available in the technology market, e.g. widgets that enable embedding to-do lists, friend lists, personal information, and web bookmarks, into their blog page.

IV. RELATED TAXONOMIES FOR TECHNOLOGY ENABLED LEARNING

Several taxonomies of technologies for learning have been proposed (Bruce &Levin 1997; Jonassen, 2000; Chickering & Ehrmann, 1996; Conole et al., 2004). For example, we can think of tools and systems for reading, thinking, communicating, and acting in the world:

- Technologies as media for accessing and studying learning material: Software systems like Learning Management Systems (e.g. Blackboard, Moodle) or Learning Objects Repositories (e.g. MERLOT) are being widely used for the dissemination/ acquisition of educational material in various formats.
- Technologies as media for learning through inquiry: One example is the WISE learning environment, which has been developed in Berkeley, where learners examine real world case studies and analyse current scientific controversies (http:// wise.berkeley.edu/). STOCHASMOS is a web-based learning environment developed at the University of Cyprus, which allows learners to investigate, organise and interpret complex and diverse scientific data and phenomena (http://www.stochasmos.org). Of course, simulation environments like STELLA, Stagecast Creator, Cabri, have been effectively used in learning environments.
- Technologies as media for learning through communication and collaboration: Many computer-supported collaborative learning (CSCL) systems, such as CENTRA, DimDim, Synergeia, CoolModes, have been developed to facilitate synchronous and asynchronous collaborative learning tasks. Nowadays, wikis, blogs as well as 3D shared worlds like Secondlife, ActiveWorlds are being extensively used in learning scenarios for various courses (Alexander, 2006).
- Technologies as media for learning through construction: Various software tools have been developed for enabling learning by doing. Typical

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examples are lego-like logo robots (Turner, 2006). Learners build robots out of LEGO pieces, using not only the traditional LEGO building bricks but pieces like gears, motors, and sensors. They also build complex computer programs by "snapping together" Logo commands thus adding behaviour to the LEGO.

- Technologies for learners' assessment: Several freeware and commercial self-assessment tools (e.g. HotPotatos, Question Mark Perception) have been designed for assessing learners' knowledge. Nowadays, there is a tendency to build tools that allow new methods of evaluations such as Electronic Portfolios which offer capabilities for storing, displaying and reviewing/grading learners' work in a variety of formats (Meyer & Latham, 2008).
- Technologies for digital and multimedia literacy: Various tools have been designed for supporting learning through expression using multimedia such as tools for video editing and annotating, image processing, web comics creation, and so on (Goodman, 2003; Gutierres Martin, 2003).

The role of technology is to direct, foster thinking and facilitate the acquisition of higher order skills. The challenge is to creatively use technologies by focusing upon their affordances. In a well designed technology-enhanced learning environment learners will engage in the process of manipulating information and critical thinking as well as expressing and sharing their knowledge to peer-learners.

V. CONCLUSION

In this paper we observed that technology plays a major role in engaging the learner in the whole learning process. Technology helps to bind the three internal processes of learning-observation, imitation and participation. With the use of Technology Enhanced Learning (TEL) methodologies, new opportunities for gaining knowledge can be sought [8].

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